

## **AMENDMENTS TO THE CLAIMS**

Please cancel claims 1-20.

Please add the following new claims:

- 1   21.   (new) A method of petrophysical evaluation of an earth formation using a logging  
2           tool conveyed in a borehole in said formation, the method comprising:
  - 3           (a)     obtaining values of a horizontal and vertical resistivity of said earth  
4                   formation using said logging tool; and
  - 5           (b)     determining a horizontal and vertical permeability of said earth formation  
6                   using said horizontal and vertical resistivities, said horizontal and vertical  
7                   permeabilities having a ratio different from a ratio of said vertical and  
8                   horizontal resistivities.
- 9
- 1   22.   (new) The method of claim 21 wherein said earth formation comprises a sand  
2           component and a shale component.
- 3
- 1   23.   (new) The method of claim 21 wherein determining said horizontal and vertical  
2           permeabilities further comprises determining a water content of said formation  
3           from said horizontal and vertical resistivities.
- 4
- 1   24.   (new) The method of claim 23 wherein determining said horizontal and vertical  
2           permeabilities further comprises determining an estimate of bulk irreducible water

3 content of the formation from NMR measurements.

4

1 25. (new) The method of claim 23 wherein determining said water content of said  
2 formation further comprises:

3 (i) inverting said values of horizontal and vertical resistivities of the  
4 formation using a petrophysical model to give a first estimate of fractional  
5 volume of laminated shale in the formation;

6 (ii) obtaining measurements of density and/or neutron porosity of the  
7 formation and using a volumetric model for deriving therefrom a second  
8 estimate of fractional volume of laminated shale; and

9 (iii) if said second estimate of fractional shale volume is greater than said first  
10 estimate of fractional shale volume, inverting said horizontal and vertical  
11 resistivities using a petrophysical model including said second estimate of  
12 fractional shale volume and obtaining therefrom a water content of the  
13 formation.

14

1 26. (new) The method of claim 21 further comprising determining a vertical and  
2 horizontal resistivity of an anisotropic sand component of the formation, and  
3 determining therefrom and from at least one additional measurement selected  
4 from the group consisting of: (i) NMR measurements of the formation, and, (ii) a  
5 bulk permeability of the sand component, a parameter of interest of a coarse and a  
6 fine grain portion of the sand component.

7

1 27. (new) The method of claim 21 further comprising using a transverse induction  
2 logging tool for obtaining said values of horizontal and vertical resistivities of the  
3 formation.

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1 28. (new) The method of claim 21 further comprising using an induction logging tool  
2 for obtaining said values of horizontal resistivities and a focused current logging  
3 tool for obtaining said values of vertical resistivities

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1 29. (new) The method of claim 25 wherein using said volumetric model further  
2 comprises using at least one of: (i) the Thomas-Stieber model, and, (ii) the  
3 Waxman-Smits model.

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1 30. (new) The method of claim 21 wherein further comprising determining a  
2 parameter of interest is selected from the group consisting of: (A) a fractional  
3 volume of said coarse grain component, (B) a fractional volume of said fine grain  
4 component, (C) a water saturation of said coarse grain component, (D) a water  
5 saturation of said fine grain component, (E) a permeability of said coarse grain  
6 component, and, (F) a permeability of said fine grain component.

7

1 31. (new) The method of claim 26 wherein the at least one additional measurement  
2 comprises an NMR measurement, and deriving the parameter of interest further

3 comprises deriving a distribution of relaxation times from said NMR  
4 measurements and obtaining therefrom a distribution of components of said  
5 anisotropic sand.

6  
1 32. (new) The method of claim 26 wherein the at least one additional measurement  
2 comprises a bulk permeability measurement of the anisotropic sand and deriving  
3 the parameter of interest further comprises:

- 4 A. obtaining a family of possible distributions of volume fractions and bulk  
5 irreducible water content (BVI) for the coarse and fine sand components;
- 6 B. determining horizontal, vertical and bulk permeability values associated  
7 with said family of possible distributions; and
- 8 C. selecting from said family of possible distributions the one distribution  
9 that has a determined bulk permeability substantially equal to the  
10 measured bulk permeability.

11  
1 33. (new) The method of claim 32 wherein said bulk permeability is obtained from  
2 the group consisting of (I) NMR diffusion measurements, (II) a formation testing  
3 instrument, (III) a pressure buildup test, and, (IV) a pressure drawdown test.

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1 34. (new) The method of claim 32 wherein determining the horizontal and vertical  
2 permeability values associated with said family of distributions for the coarse and

3 fine sand components further comprises using the Coates-Timur equation

4 
$$k = \left( \frac{\phi}{C} \right)^a \cdot \left( \frac{\phi - BVI}{BVI} \right)^b$$

5  
6 where  $k$  is a permeability,  $\phi$  is a porosity,  $BVI$  is the bound volume irreducible,  
7 and  $a$ ,  $b$ , and  $C$  are fitting parameters.

8  
1 35. (new) The method of claim 32 wherein determining horizontal, vertical and bulk  
2 permeability values further comprises using a relationship of the form

3 
$$k = C \phi^a T^b$$

4 where  $k_e$  is a permeability,  $\phi$  is a porosity and  $T$  is a NMR relaxation time, and  $a$ ,  
5  $b$ , and  $C$  are fitting parameters.

6  
1 36. (new) The method of claim 35 wherein  $T$  is a longitudinal NMR relaxation time.

2  
1 37. (new) The method of claim 32 wherein the coarse sand portion of the selected  
2 distribution is characterized by an irreducible water saturation less than an  
3 irreducible water saturation of the fine grain sand portion of the selected  
4 distribution.

5  
1 38. (new) The method of claim 32 wherein the determined bulk permeability is a

2 spherical permeability related to the horizontal and vertical permeability values by  
3 a relationship of the form

4 
$$k_{sph} = \left( k_h^2 k_v \right)^{\frac{1}{3}}$$